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SUPERFUND: Reporting on Progress Through Environmental Indicators

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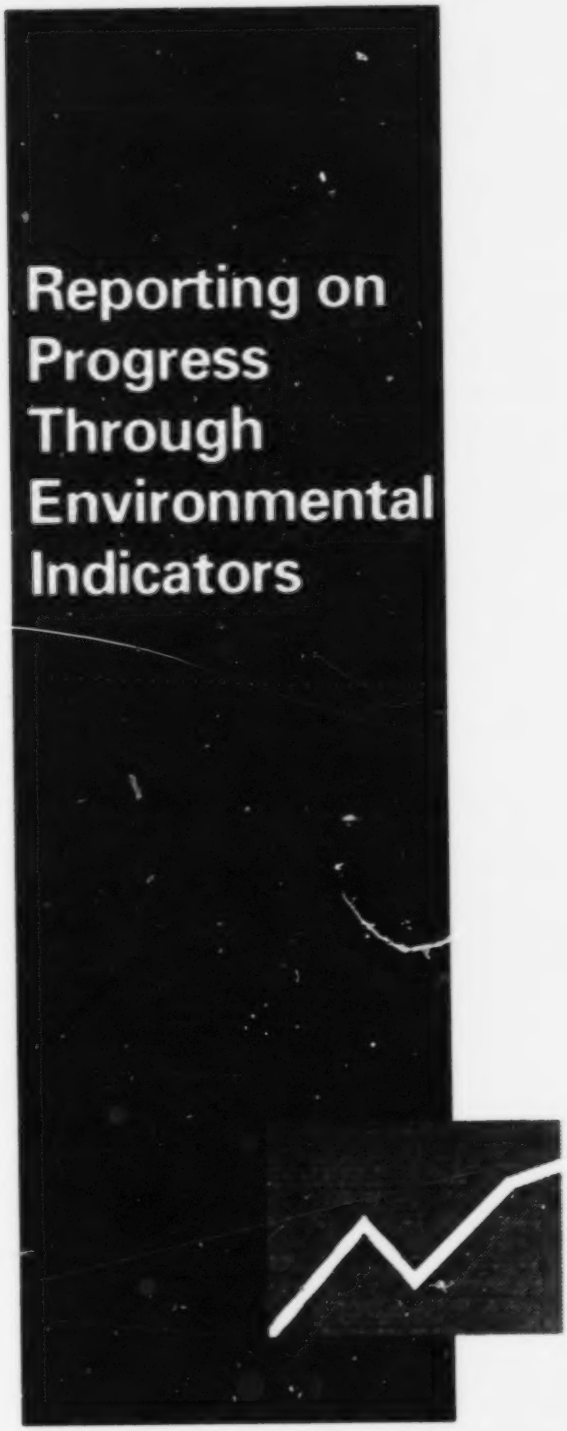

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Provides background information on the study conducted of Superfund sites using environmental indicators to determine the extent to which Superfund goals have been achieved, e.g., making sites safe and making sites clean. The report examines the work done over the past ten years to show progress and accomplishments on sites that have not yet been deleted from the NPL.

Document is intended for persons with basic knowledge of the superfund program.

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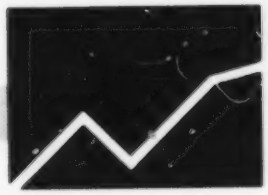


Executive Summary

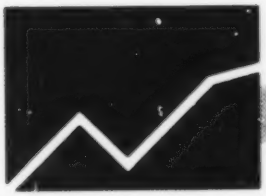
Environmental Data Collection is a New Effort. Superfund, the Nation's environmental program to clean up abandoned and uncontrolled hazardous waste sites, has been in operation for almost ten years. During that period, thousands of actions have been taken to reduce risk to humans and the environment near those sites. Permanent cleanup of any one hazardous waste site can take a number of years, yet substantial progress toward controlling or removing risk can be made before a site is finally declared clean. Data on interim risk reduction have never been systematically collected. This report is the first effort by the Environmental Protection Agency to examine the work it has done over the past ten years to show progress and accomplishments on sites that have not yet been deleted from the list of the most dangerous areas.

During the past ten years, thousands of actions have been taken to reduce risk to humans and the environment.

This Report is Based on a Sample of Sites. In assembling data for this study, EPA studied all National Priorities List (NPL) sites where cleanup work had been initiated as well as all emergency actions at non-NPL sites that cost more than $200,000. This report documents progress at 604 sites, including 422 sites from the NPL (the most dangerous waste sites in the country) and 182 nor NPL sites. In addition, there were over 1,100 other non-NPL sites, not included in this report, where emergency action was taken to reduce risk to human health and the environment. Sites were chosen for intensive study for this report only if actual physical cleanup work had occurred and adequate documentation was available.

Summary of Important Results. The Superfund program can now document that:

• *EPA Has Assessed Immediate Danger and Taken Action to Make Sites Safe.* Over the past year, EPA has examined all the sites on the NPL and taken action necessary to reduce or eliminate the most serious immediate threats to human health or the environment. This report documents the results of EPA's cleanup activities performed at 356 NPL sites to make them safe. At 252 of these sites, there were also actions that have served to move the site closer to achieving health and environmental goals. Once waste is permanently removed, treated or contained it poses no future danger at a site.



Environmental Progress

• *EPA Has Made Substantial Progress Toward a Permanent Cleanup that will Meet Human Health and Environmental Goals at a Large Number of NPL Sites.* Demonstrable progress toward permanent cleanup that will meet human health and environmental goals has been documented at 318 of the Nation's most serious hazardous waste sites (those listed on the National Priorities List). This constitutes about one-quarter of the NPL sites.

Cleaning up the land has progressed the farthest; groundwater is the most difficult to clean up. The task that lies ahead is still large: in the future, simply to clean up present NPL sites and to handle emergencies that may arise, EPA estimates the government must spend about $22.5 billion. However, this report clearly documents that worthwhile, measurable progress has already been achieved in return for the approximately $3.5 billion that was *spent* over the first nine years of the program.

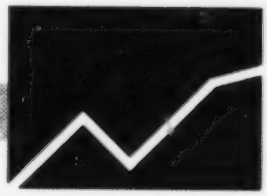
Demonstrable progress toward permanent cleanup that will meet human health and environmental goals has been documented.

• *The Physical Volumes of Material that have been Removed from the Environment in Conducting the Superfund Program are Impressive.* In the course of taking the various protective actions detailed at the sites covered in this report, EPA has handled enough solids to cover more than 500 football fields to a depth of ten feet and enough liquids have been treated to give almost 20 gallons to every man, woman, and child in the United States. Although physical volumes are a poor measure of actual risk reduction, they provide a useful measure by which to understand the magnitude of the Superfund program and help explain its duration and cost.

Background

Superfund Management Review. In 1989, Administrator William K. Reilly commissioned a study of management issues associated with the Superfund program. Three of the themes of the Superfund Management Review were (1) that the program should make all sites safe, (2) that the program should deal with worst sites and worst problems first, and (3) that the program should develop measures of interim cleanup progress that relate to the ultimate goal of Superfund, which is the reduction of human and environmental risks associated with hazardous waste sites. As the Review noted,

> The principal expectation of the public is that EPA and PRPs [potentially responsible parties] will take the necessary steps to



control the risks to human health and the environment from abandoned hazardous waste sites. The public wants to see action to remove, treat, or contain hazardous substances, and progress toward achieving the human health and ecological goals on and near the sites.

To meet these challenges, first, Superfund undertook a complete assessment of all the sites during fiscal year 1990 to be certain that it could meet the directive to make sites safe — not permanently cleaned up, but safe. In the course of that review, some 50 sites were found where work was needed to assure public safety, and that work was then undertaken. Second, Superfund developed procedures to insure that the most highly contaminated areas, whether parts of an individual site or sites as a whole, were dealt with promptly, even if it meant that longer-term cleanup at other sites had to be delayed to achieve that goal.

This report responds to the third directive: to develop reports that link Superfund activities to the goal of protecting health and the environment. The study team examined *all actions* at sites on the National Priorities List and the *most significant actions* at non-NPL sites in order to establish a baseline for documenting the environmental progress that had been made as of the fall of 1989.

This report links Superfund activities to the goal of protecting health and the environment.

It is important to remember that this is the first such study of interim progress by the Superfund Program. Therefore, some data that will make future editions of this report more useful or more comprehensive have not been included, some analysis needs refinement, and some information may need to be recast to be more comprehensible to users. Just as important, because there are no data to which information in this report can be compared, it is difficult to use this as a yardstick for EPA's performance. It is helpful to think of this report as the first frame in a future series of snapshots, which when taken together will provide an ongoing record of Superfund's progress and efficiency in meeting the goals that Congress established.

Framework of the Study. The Superfund program conducts its work against a background of high expectations, great complexity, and public urgency. There are a growing number of sites that contain unknown quantities, types, and combinations of waste. Some of the newer cleanup technologies are not yet proven to be effective. The

Environmental Progress

sums of money involved, although large, are not sufficient to do everything at once nor does the technical expertise exist to solve all problems, even if money were available. The basic tension that has always existed in the program is between the mandate to survey, stabilize, treat, or otherwise make the most dangerous sites safe quickly and the public's desire to see a large number of individual sites permanently cleaned up without delay. This tension has resulted in a program that EPA believes best protects health and the environment by concentrating on making all sites safe and dealing with worst sites first, but, as this report illustrates, has also resulted in a program where reporting on environmental progress is not simple and straightforward.

It is helpful to think of this report as the first frame in a series of snapshots providing an ongoing record of Superfund's progress.

• *Make Sites Safe.* In resolving this tension, EPA believes that its first obligation is to make all sites safe — temporarily if necessary, but ultimately on a permanent basis. EPA's strategy is to address the worst problems first at the maximum number of sites, with further environmental progress often taking place in stages. Emergency measures may involve, for example, draining a lagoon of contaminated materials and trucking the liquids and any drums found on the site to an off-site facility for destruction. In such a case, the site may still be contaminated, but the worst problems are under control. Ultimate cleanup of other areas of concern on the site may take place over a period of years as the surface soil is dug up and cleaned and groundwater is treated and then reinjected into wells drilled for that purpose.

• *Worst Problems/Worst Sites First.* Once all sites are safe — and new sites, as discovered, are made safe — EPA seeks out and addresses the worst problems at individual sites first, with the view toward dealing with the most hazardous areas and contaminants first. In the past year, Superfund has developed a prioritization system designed to select those sites and parts of sites that need early attention. Rank ordering is done annually, with interim updates as needed.

• *Documenting Progress in the Environment.* The phased approach to Superfund activities helps insure that EPA addresses both the most important safety issues and the worst problems at a maximum number of sites. It also makes it hard to report environmental progress in any very simple fashion. At a given site, EPA may have cleaned up the surface water completely, returning it to established standards; work may be incomplete but well along in cleaning up the land in the northern section of the site and completed in the southern section; meanwhile, work may just have started on address-

ing groundwater problems. These kinds of actions do not easily lend themselves to a single, simple number or graph setting out environmental progress.

For the purposes of this study, EPA has chosen to look at three different parts of the environment at a site: (1) the land surface (including the soils that are treated as part of a cleanup, together with solid and liquid wastes found on or near the surface), (2) the groundwater (see Figure 1), and (3) the surface water (including lakes, ponds, slow-moving streams, and marshes). In addition, however, the report distinguishes between those actions taken on an emergency basis to make sites safe and those actions taken that address long-term health and environmental goals, even though a single action may have both short-and long-term cleanup benefits. Since any one site may have various contaminated areas, each of which threatens health and the environment in a different way, there is no single number or indicator of progress that can take these complexities into account while retaining its accuracy. Thus, it is not surprising that some actions appear in several different categories and numbers may not add up easily in an intuitive fashion.

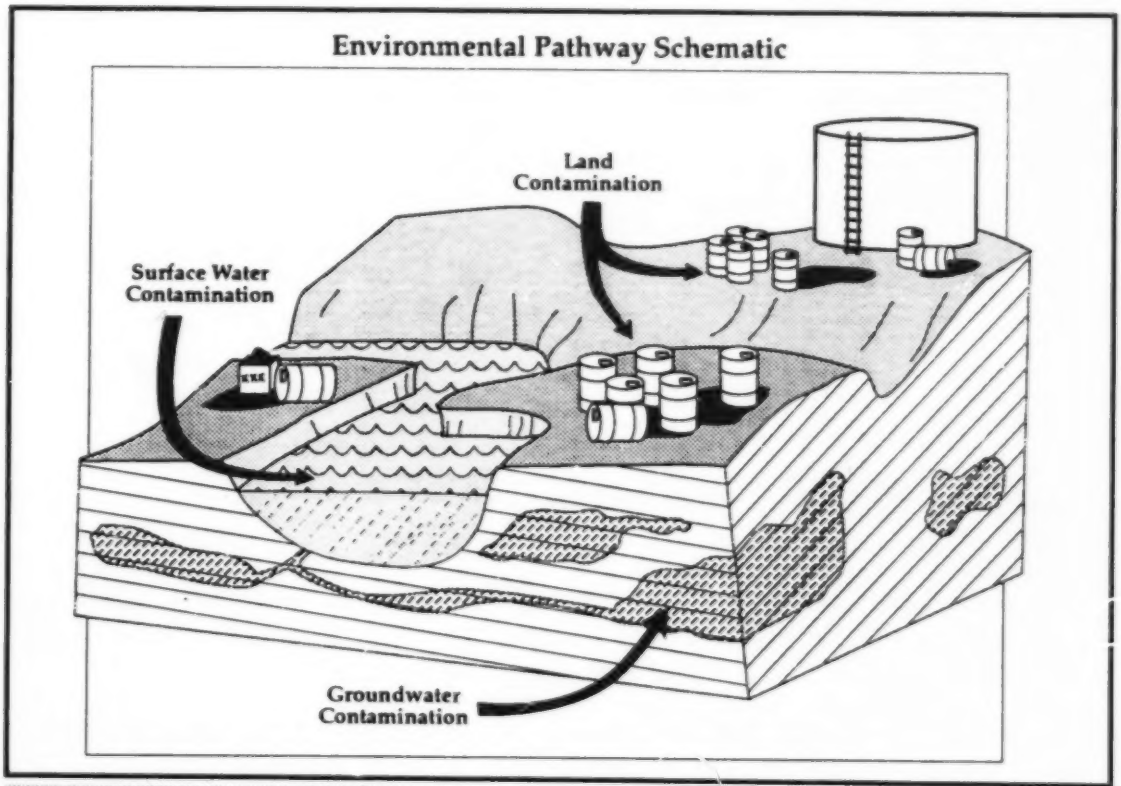
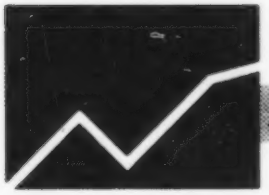


FIGURE 1



Environmental Progress

Selecting Sites to Study. For the purposes of this study, EPA analyzed information on all sites on the NPL where cleanup work has actually begun, and sites not on the NPL where the Federal government has spent $200,000 or more in actual cleanup. Figure 2 shows how the set of 604 sites with progress documented in the environmental indicators study compares to the universe of sites on the NPL and non-NPL sites with cleanup actions taken. As that Figure illustrates, among the 1,236 sites on the NPL, 422 sites had actual environmental progress to report that was supported by adequate, unambiguous documentation. Likewise, from the 1,302 non-NPL sites with cleanup action, 182 sites cost more than $200,000 to clean up and had adequate, unambiguous documentation.

What Counts As Progress for this Report.

- *"Progress" Defined*. Real environmental progress at these 604 sites is the basis for this report. Prior public and technical reports issued by the Superfund program have concentrated on administrative or management milestones. In contrast, this report counts only tangible physical activities that constitute cleanup. Merely initiating construction

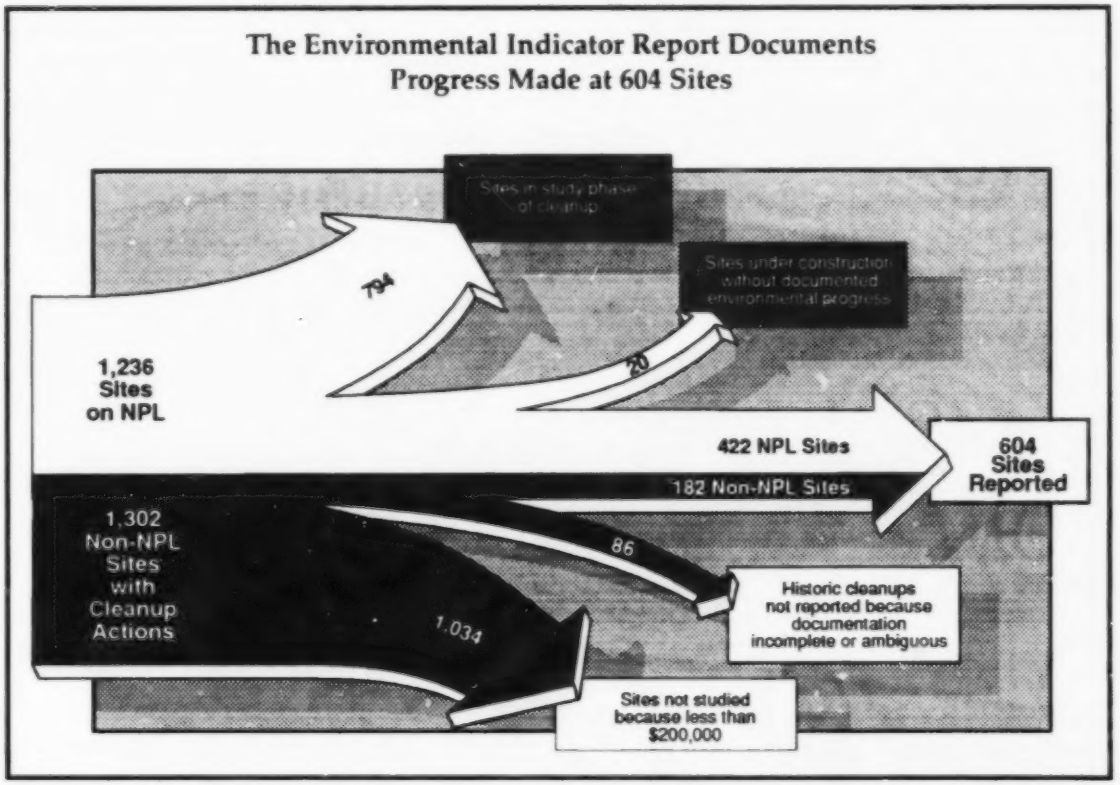
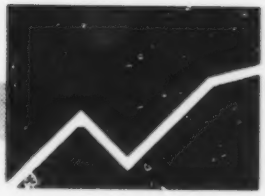

The Environmental Indicator Report Documents
Progress Made at 604 Sites
Sites in study phase of cleanup
Sites under construction without documented environmental progress
794
20
1,236 Sites on NPL
422 NPL Sites
604 Sites Reported
182 Non-NPL Sites
1,302 Non-NPL Sites with Cleanup Actions
86
1,034
Historic cleanups not reported because documentation incomplete or ambiguous
Sites not studied because less than $200,000

FIGURE 2



of an incinerator, for example, is not counted as progress in this report. It may take more than a year to construct and test the incinerator; this report measures progress only after soil incineration actually begins. Throughout this report, progress is only claimed when actual physical cleanup activities on the site have taken place.

• *Categories Used to Report Progress.* This report divides the actions that have been taken into two major categories: **Acute Threats Addressed** and **Achievement of Health and Environmental Goals.** The report supplements these two major measures with a third: **Quantities of Waste Removed from the Environment.** The two major categories reflect, in part, the way that EPA approaches problems at a new site. It first moves in and cleans up the most dangerous problems, addressing the acute threats. In many cases, these emergency actions are all that are required to make an area free from danger; no long-term work is ever required. On the other hand, at other sites — those that are placed on the National Priorities List — long-term work and monitoring must be undertaken. In those cases, this study reports on the progress EPA is making toward achieving the health and environmental goals it established for the site.

This report counts tangible physical activities that constitute cleanup.

Reporting on Sites Where Actions Have Been Taken to **Address Acute Threats**: These actions are designed to reduce threats and their success is measured against that standard. These actions may be taken at either NPL or non-NPL sites and may include temporary actions to stabilize a site, quick actions that may permanently remove a threat, or actions that have a truly long-term effect in removing contamination from a site. The actions are taken in order to reduce danger without delay; any given action can result in either short-term or long-term cleanup, depending on the site and on the remedy used.

Reporting on Sites Where There Have Been Actions Taken to **Achieve Health and Environmental Goals**: In the case of sites on the NPL where long-term progress toward achieving goals has been documented, the situation is more complex. The "goals" are those established in the appropriate administrative Record of Decision (ROD), which is designed to set permanent goals for cleaning up a site. For example, if groundwater at a particular site is contaminated, the goals will usually be expressed in terms of the concentration of key contaminants that must be achieved before the subsurface water is

considered clean. If the groundwater is (or might be) used as drinking water, that goal is the achievement of national drinking water standards. In some cases — particularly for the land surface — varying goals are established for different areas of a given site. These varying goals may reflect the presence of different kinds or concentrations of contaminants, for example. Different parts of one single site may be at different stages of cleanup — for example, some land areas may be clean while work on other areas has not yet begun. In this report, EPA categorizes *all* work that is designed to meet these long-term goals at a site or that makes progress toward permanent cleanup as either ***Cleanup Initiated*** or ***Progress Toward Cleanup***. These measures can be described as follows:

Different parts of a site may be at different stages of cleanup.

- Work at a site is classified as ***Cleanup Initiated*** when hazardous wastes or contaminated water and soil have actually been moved at a site, but work has not gone far enough to claim with any certainty a great deal of progress. Work on the site is underway, hazards may in fact have been reduced, but EPA is not yet claiming credit for even partial success.

- ***Progress Toward Cleanup*** is used to describe the case where one or more contaminated areas — such as two out of three lagoons or the northern section but not the southern section of a site — have been cleaned up to meet permanent health and environmental standards, but not all of the work for the particular site has been done. In some cases, it is possible to declare full success in cleaning up a part of the environment: the land is clean, the surface water is clean, and so on.

In summary, then, this report presents the data from several different viewpoints:

- The **objectives** of the cleanup action that has been undertaken, noting whether it was done to ensure that acute threats are being addressed or whether EPA is attempting to achieve long term health and environmental goals;

- The particular **part of the environment** being addressed: land surface, groundwater, or surface water.

- In the case of acute threats addressed, information on **how the progress was achieved:** by removal, treatment, or containment, by providing alternative water supply, by population relocation or by providing site security; and
- In the case of achievement of health and environmental goals, how much **success** is being claimed for a particular site or part of the environment: cleanup initiated or progress toward cleanup achieved.

Environmental Progress: The Data

As Figure 3 shows, EPA has documented environmental progress at 604 sites: 422 NPL sites (shown in white) and 182 non-NPL sites (shown shaded). The actions taken have addressed *acute threats* at 538 sites (104 NPL sites with *only* acute threats addressed plus 252 NPL sites that *also* have acute threats addressed plus 182 non-NPL sites with acute threats addressed) and addressed *achieving health or environmental goals* at 318 NPL sites. Because contamination at NPL sites can require activities both to control acute threats

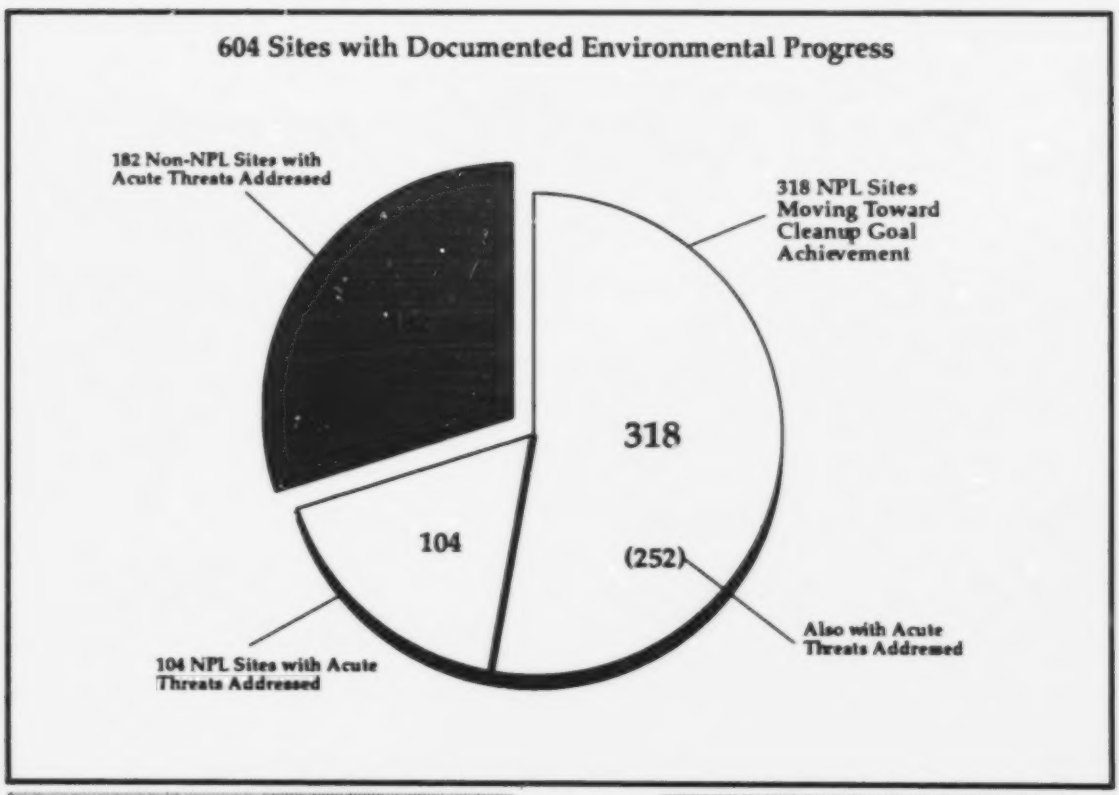

604 Sites with Documented Environmental Progress
182 Non-NPL Sites with Acute Threats Addressed
318 NPL Sites Moving Toward Cleanup Goal Achievement
318
104
(252)
104 NPL Sites with Acute Threats Addressed
Also with Acute Threats Addressed

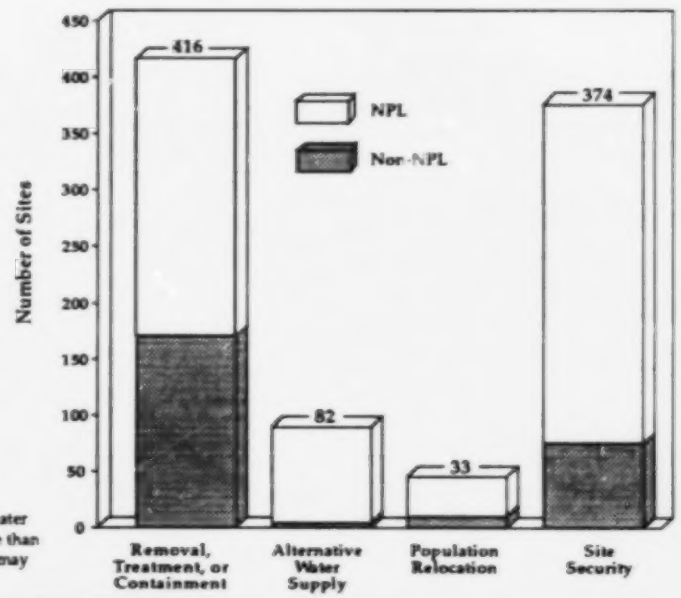
FIGURE 3

and provide permanent cleanup, some of the 422 NPL sites (shown in white on the figure) show progress in more than one category above.

Addressing Acute Threats. This category reports all emergency actions at NPL sites and emergency actions that cost more than $200,000 at non-NPL sites. These actions include: providing alternate water supplies; evacuating and relocating people; site security measures; stabilizing waste to prevent fire or explosion; and removing, treating, or containing hazardous waste. In the case of non-NPL sites, environmental progress is all included in this category; none of it is reported as achieving long-term health and environmental goals, even if a particular action has that result. This is because EPA does not set long-term health and environmental goals when it works on non-NPL sites, but rather takes action to reduce immediate risk to human health and the environment.

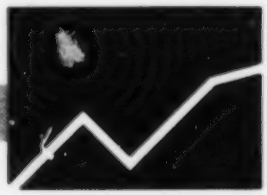
• *Numbers by Various Categories of Actions Taken*. At 538 sites, immediate actions to protect nearby populations and to control the threat of exposure to hazardous contaminants have been taken. As Figure 4 shows, 416 of those actions involved removal,

At 538 Sites, Actions Ranging From Waste Treatment to Site Security Have Addressed Acute Threats



Site numbers add up to greater than 538 sites because more than one risk reduction activity may occur at any one site.

FIGURE 4



treatment, or containment of the waste; 82 provided alternative water supplies; 33 involved population relocation, and 374 provided site security by fencing or guarding the site. (Because several actions are often taken at any given site, these numbers add up to more than the total number of sites studied.) EPA has taken similar actions at over 1,100 other non-NPL sites where activities to control acute threats resulted in the removal, treatment or containment of waste; as mentioned earlier, these activities are not included in this report.

• *Estimates of Numbers of People Protected.* Although it is difficult to estimate the number of people protected by some of these measures, the best available data suggest:

More than 267,000 people have been provided with alternative residential water supplies, and

More than 19,000 people were evacuated or relocated during site cleanup activities. After cleanup, 87 percent of them returned to their homes; the rest have been permanently relocated.

Achievement of Health and Environmental Goals. Progress toward meeting health and environmental goals has occurred at a great many sites on the National Priorities List and in several different environmental pathways (see Figures 5 and 6):

• *Total Number of Sites.* Work that has resulted in progress toward achieving permanent cleanup goals has occurred at 318 sites. As Figure 5 shows, cleanup has been initiated at 67 of these sites, while progress toward cleanup has taken place at the remaining 241 of the sites. (Although not shown on the graph, 65 of the 241 sites have actually achieved permanent cleanup of the land, the groundwater or the surface water.)

318 NPL Sites Are Moving Toward Achieving Cleanup Goals

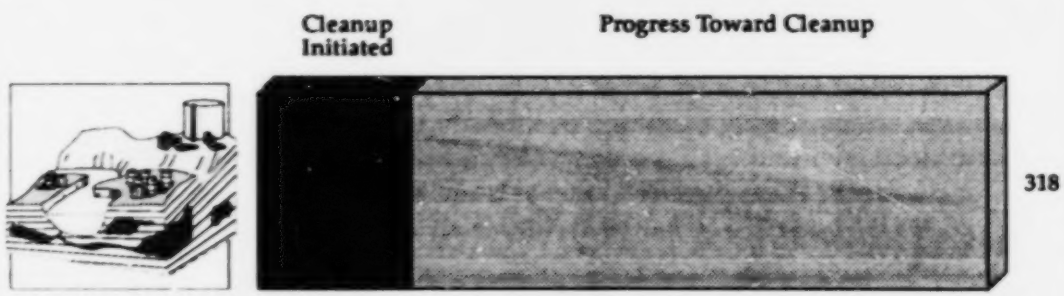


FIGURE 5

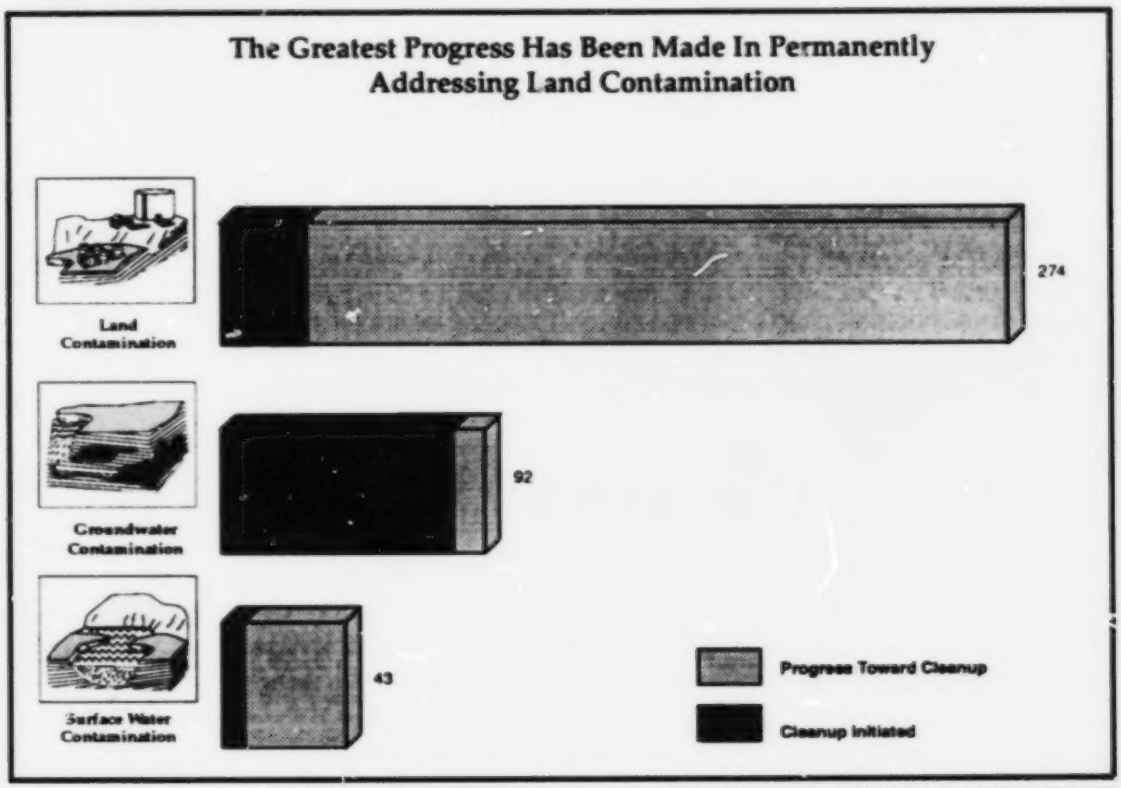


FIGURE 6

Land Cleanup: At NPL sites, land has been addressed at 274 sites (see Figure 6). Land cleanup is frequently undertaken first because it substantially reduces risks to people, animals, and plants that might otherwise come into direct contact with waste at a site. Land cleanup can also forestall future groundwater cleanup by removing a source that may percolate into the subsurface water. Land cleanup has been initiated at 30 sites; at 244 other sites, progress toward cleanup has been achieved. (Although not shown on the graph, 60 of the 244 sites have actually achieved permanent cleanup of the land.)

Groundwater Cleanup: Most sites have actual or potential groundwater problems, and the physical cleanup of subsurface water has proven to be a very difficult environmental problem. Groundwater cleanup is occurring at 92 sites, including 81 sites where cleanup has been initiated and 11 sites where the groundwater pathway has been completely cleaned up (see Figure 6).

Surface Water Cleanup: Cleanup goals for surface water contamination are being addressed at 43 NPL sites (see Figure 6). Cleanup has been initiated at 8 sites; at 35 sites, progress has been made. (Although not shown on the graph, 11

of the 35 sites have actually achieved permanent cleanup of surface water.)

Quantities of Waste Removed from the Environment *and Technologies Used*. The sheer volume of hazardous waste that has been moved in cleaning up these sites illustrates progress. However, absolute information about volumes and quantities is not always available, and the amount of waste handled to date is only rarely reported as a comparison to the total amount of waste remaining to be moved. Therefore, this information is provided only as a general progress indicator. In describing information in this category, EPA also reports the types of technology (i.e., treatment or containment) that have been used to manage wastes. "Treatment" covers waste management technologies that permanently reduce the toxicity, mobility, or volume of contaminated materials. Examples include incinerating contaminated soils or liquid wastes, and pumping and treating groundwater to remove contaminants. "Containment" refers to technologies that keep contaminated materials from spreading or keep people or animals from coming into contact with them. It includes movement of hazardous wastes into a permanent containment facility, such as a highly secure landfill. It can also include temporary controls to prevent waste movement or migration until a permanent remedy can be applied. Containment is often appropriate for wastes of high volume and low toxicity or mobility.

• *Quantities of Waste Managed*. EPA has data on the volume of materials handled and the technologies used at 499 sites (329 NPL sites and 170 non-NPL sites). Figure 7

Quantities of Waste Managed

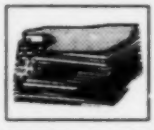
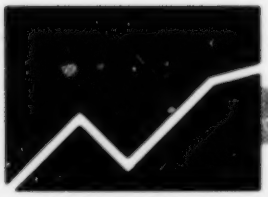
Pathway		Volumes Addressed
	Land Surface:	
	Soil	4,130,000 cubic yards
	Solid Waste	5,270,000 cubic yards
	Liquid Waste	1,000,000,000 gallons
	Groundwater:	3,880,000,000 gallons
	Surface Water:	104,000,000 gallons

FIGURE 7



shows these volumes by the environmental pathway affected. These volumes are so large that they are hard to conceptualize, so some comparisons may help:

Land Contamination includes both solids and liquids. Soils and other solid wastes handled so far total 9,400,000 cubic yards; this amounts to 5,000 football fields covered with these wastes to a depth of one foot. Liquid wastes total 1,000,000,000 gallons, or about 4 gallons for every man, woman, and child in the United States.

Contaminated **groundwater** treated to date totals about 3,880,000,000 gallons, equivalent to about 15 gallons for each person in the United States.

Contaminated **surface water** treated to date totals 104,000,000 gallons, equivalent to about one-half gallon for each person in the United States.

• *Technologies Used in Cleanup Actions.* Progress data gathered for this study (which includes cleanup actions that occurred since the beginning of the program in 1980) show that cleanup actions at 55 percent of the 318 NPL sites moving toward final cleanup used treatment technologies such as incineration, air stripping, and thermal treatment. In the land pathway, contaminated soils and solids were most often contained. Contaminated groundwater and surface water were almost always pumped and treated.

The percentage of sites using technologies that permanently reduce the toxicity, mobility or volume of contaminants is increasing.

The use of treatment instead of containment will increase, based on an analysis of RODs signed between FY 87 and FY 89. Treatment is a more permanent solution to hazardous waste problems. In FY 87, some type of waste treatment was recommended in just over 50 percent of the cleanup remedies proposed, rising to more than 72 percent by FY 89. As more sites move into the active cleanup phase, the percentage of sites addressed by treatment technologies will continue to increase, permanently removing contaminants from the environment.

SUMMARY

The legacy of problems posed by uncontrolled and abandoned hazardous waste sites is a formidable challenge. These problems are both more numerous and more complex than originally thought when the original Superfund legislation was enacted in 1980. To achieve maximum environmental protection at the greatest number of sites using available resources, EPA's Superfund program has adopted a strategy of immediately making sites safe from acute threats to human health and the environment, and then progressing toward permanent cleanup of the worst problems first at NPL sites.

The environmental indicators in this report summarize these actions to control contamination in several environmental pathways — land surface, groundwater, and surface water — and actions that control discrete areas of contamination, such as lagoons and old disposal grounds. The environmental progress measured at 604 sites is a direct result of Superfund cleanup activities.

EPA intends to report annually on the Superfund program's progress in cleaning up problems posed by uncontrolled hazardous waste sites. Future reports can be compared to this baseline document to measure Superfund's incremental environmental progress. Additional indicators of environmental achievement will be developed and added to future reports.